STUDIES ON THE LOCALIZATION OF CEREBELLAR TUMORS: II. THE POINTING REACTION AND THE CALORIC TEST.

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The purpose of this paper is to discuss the importance of the pointing reaction (Barany) and the caloric test in the diagnosis of new growths in the posterior fossa. It is based upon an analysis of the records of 31 cases of cerebellar or extracerebellar tumor.

The patients were in the neurological services of Dr. Cushing at the Johns Hopkins Hospital and at the Peter Bent Brigham Hospital. With a few exceptions they have all been personally studied by the writer. In 5 cases the examinations were made by Dr. Cushing and Dr. S. J. Crowe at the former institution.

The diagnosis and localization of the lesions were confirmed in all of the cases either at operation or on postmortem examination. All records have been excluded which showed that the disease had extended into other parts or which included additional factors likely to confuse the symtom-complex.

The present report is one of a series of studies which were suggested by the difficulties attending the localization of many cerebellar tumors.[1] Notwithstanding the important contributions which have appeared since Barany suggested the use of the caloric and the pointing tests, there is still much difference of opinion in regard to the interpretation of these and other cerebellar signs. For purposes of analysis, new growths in the posterior fossa have been divided into five groups: tumors of the vermis, tumors occupying one hemisphere, tumors involving most of the cerebellum, cerebellopontine tumors, and extracerebellar tumors lying inferior to the vermis.

The cases are numbered and presented in the same order in the reports of the pointing reactions and the caloric tests. In this way the data from each patient in the two groups may be compared.

The pointing reactions and the caloric tests were carried out in the manner described by Barany.[2]

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[1] Grey, Studies on the Localization of Cerebellar Tumors: I, Staggering Gait, Limb Ataxia, the Romberg Test, and Adiadococinesia, Jour. Nerv. and Ment. Dis., 1915, xlii, 670. II, On Localization of Function in the Canine Cerebellum, ibid., to appear soon. Studies on the Localization of Cerebellar Tumors: III, Posterior New Growths without Nystagmus, Jour. Am. Med. Assn., 1915, lxv, 1341.

[2] Wien. klin. Wchnschr., 1912, xxv, 2033 and Tr. Internat. Cong. Med., 1913, Lond., 1914, Sect. xi, Neuropath. pt. 2, 53; Friesner and Braun, The Functional Tests of the Static Labyrinth in Neurological Diagnosis, New York Med. Jour., 1914, c, 369; Layton, Examination of the Internal Ear and Hind Brain by Stimulation of the Vestibular Nerve, Clin. Jour., London, 1914, xliii, 193.

NEW GROWTHS INVOLVING THE VERMIS. *Pointing Reaction.* The pointing reaction was tried with three patients having median tumors involving the vermis. In each case the examination was made previous to operative measures. (1) One (solitary tubercle measuring 3 cm. across) pointed correctly in all of the tests during three separate investigations.

(2) A second (cyst lying more to the left of the midline—about 30 c.c. fluid) likewise performed each of the reactions correctly on two different occasions, but thirteen days following a suboccipital decompression with emptying of the cyst both arms were found to deviate outward. The head also showed a slight pointing error —to the patient's right.

(3) In the third patient (large glioma involving all of the vermis and the dentate nucleus of each hemisphere) the right leg occasionally deviated inward. The right arm also showed a pointing error upward.

Caloric Test. The three patients mentioned above were investigated with the caloric test. In the first of these (1), three separate examinations were made on different days. No spontaneous nystagmus was ever elicited. During all three examinations, stimulation of the left labyrinth provoked a more marked nystagmus than stimulation of the right. In the two earlier tests, irrigation of the right ear resulted in reaction movements in the right arm only, whereas irrigation of the left caused the appearance of typical reaction movements in both upper limbs. In the third examination the same type of reaction followed the irrigation of each ear.

(2) The second patient was studied on two separate occasions previous to his operation and once following it. A moderate spontaneous nystagmus was present at times with its quick component directed to the left. Looking to the left brought out slower and coarser jerks than looking to the right. Practically the same type of reaction resulted from the stimulation of the two labyrinths. This consisted of a rather marked nystagmus and normal reaction movements. The artificial nystagmus did not completely obliterate the spontaneous jerks. In the third examination, conducted on the thirteenth day after operation, the nystagmus resulting from the irrigation of the left ear was much less marked than that which appeared from the opposite side. On stimulating the left labyrinth, however, reaction movements were obtained in all of the parts, whereas on stimulating the right side the reactions appeared only in the homolateral limbs.

(3) The third patient was examined only once, as he died of respiratory failure some hours after admission. During the investigation there was nothing to suggest an agonal condition, as he sat in a chair without apparent discomfort, and was able even to walk across the room on his hands and knees.

When the patient looked forward a slight nystagmus was visible, the quick component being directed to his left. Coarse jerks of equal range and rate appeared on looking to either side. On stimulating the labyrinths, well-marked reaction movements appeared in the head, trunk, and limbs of either side. The degree of nystagmus was likewise increased, but the artificial never completely obliterated the spontaneous jerks.

Hearing was not affected in any of these patients. In one no subjective discomforts followed the irrigation of either ear. A slight dizziness, however, resulted from the tests in the other two patients.

NEW GROWTHS INVOLVING ONE HEMISPHERE. *Pointing Reaction.* This test was tried on 10 patients. Of these 6 were investigated previous to operative interference. The results from the latter were as follows. (1) One (large glioma) performed the tests correctly with his arms, but the leg opposite to the side of the lesion deviated somewhat outward. Following the operation both arms deviated outward and downward, and the head inclined slightly away from the lesion. (2) The second patient (large gliomatous cyst) showed a pointing error inward with both arms. (3) The third (large gliomatous cyst) was studied on seven separate occasions. In the first examination, made previous to operative interference, there was an outward deviation of the arm homolateral to the lesion. Later, following a subtemporal and a suboccipital decompression, the test was performed correctly during three examinations, made at intervals of a month. Still later both arms deviated slightly outward and upward. In two additional months both were again normal in their movements. The final examination, made after five weeks, showed a slight inward and downward deviation of the arm contralateral to the side of the tumor. (4) (Multiple tubercles involving practically one entire hemisphere). Correct pointing reactions were found during three examinations on separate days. (5) The fifth (large endothelioma occupying but not invading lateral half of hemisphere) showed no pointing errors in any part. (6) In the sixth patient (large gliomatous cyst) during the first examination the reactions were all normal. On the following day, however, the left arm showed a pointing error outward. Tests made two days later again showed normal reactions.

This test was first used subsequent to an exploratory operation in 4 patients. Five months following a suboccipital decompression (7) one of these (large glioma) pointed outward with the arm homolateral to the new growth and inward with the opposite arm. Six months later the homolateral arm still inclined outward. The opposite arm, however, pointed correctly. Twelve months subsequent to a suboccipital decompression (8) a second patient (large glioma) showed an outward pointing error of both arms, more marked on the side opposite to the lesion. During a third admission (just previous to the extirpation of a large glioma) the pointing test was performed correctly on either side. The third and fourth cases were investigated two years and six years respectively after operations in which gliomatous cysts were evacuated. In the former (9) the arm homolateral to one lesion deviated somewhat outward. In the latter (10) during one examination both arms pointed correctly; in a second, however, there was an inward pointing error on the side of the cyst.

Caloric Test. This test was used in all of the 12 patients comprisin this group. In 9 of these, examinations were made previous to any operative interference. Practically a normal response followed the irrigation of each ear in 2 of the latter (2) and (11), and gliomatous cyst the size of a hen's egg. The remaining 4 reacted as follows. (1) One showed reaction movements on each side and some nystagmus when the labyrinth contralateral to the lesion was stimulated, but nothing when the homolateral side was irrigated. About four weeks after the extirpation of a large glioma from this patient, reaction movements and nystagmus were elicited through both ears. (3) A second showed reaction movements on either side and an increased nystagmus during the irrigation of the contralateral ear. Neither of these was apparent, however, when the opposite ear was stimulated. Six months subsequent to a subtemporal and a suboccipital operation, practically the same responses were obtained during two separate examinations. (4) In a third, irrigation of the homolateral ear provoked no nystagmus but caused the appearance of reaction movements on both sides—to a less extent in the homolateral arm. Irrigation of the contralateral ear resulted in well-marked nystagmus and good reaction movements in all the parts. (5) A fourth responded with nystagmus and reaction movements from the stimulation of both labyrinths. From the homolateral labyrinth, however, both were much less marked. (6) The reactions in the fifth patient were very interesting. Stimulation of the homolateral labyrinth resulted in slight reaction movements in the arm on that side. None appeared on the opposite side. The irrigation, furthermore, had no effect on the spontaneous nystagmus. Stimulation of the contralateral labyrinth caused marked reaction movements in the arm of that side, but none in the opposite limb. A coarse nystagmus also appeared. A second examination made on the following day afforded the same results, except that no reaction movements appeared in either arm subsequent to the irrigation of the homolateral ear. During both examinations the homolateral ear was found to be deaf. Preceding the onset of this illness the patient apparently heard equally well with both ears.

(8) A sixth showed less nystagmus and vaguer reaction movements when the labyrinth on the side of the lesion was stimulated. During a second admission subsequent to a suboccipital decompression irrigation of each ear provoked slight and moderate nys-

tagmus. The latter was more marked when the contralateral labyrinth was stimulated.

(12) A seventh (large gliomatous cyst) gave no response from the irrigation of either side.

(7) (9) (10) In 3 patients this test was first used five months, two years, and six years respectively following suboccipital operations. Stimulation of the homolateral labyrinth in the first of these (7) caused slight nystagmus and no reaction movements in either arm, but on the opposite side it resulted in more marked nystagmus and good reaction movements in both arms. Six months later during two examinations (on different days) practically the same results were obtained. Within a week of these investigations a huge glioma was removed from the right hemisphere.

Irrigation of each ear in the second (9) resulted in some nystagmus. There were reaction movements on both sides when the contralateral labyrinth was stimulated, but none appeared in either arm when the homolateral was stimulated. (10) The third patient was irrigated both with cold and with combined hot and cold solutions. While they increased the spontaneous nystagmus from each ear no reactions were noted in any limb, in the head, or in the trunk. A repetition of this examination made one year later gave the same results.

As a rule, no subjective discomforts resulted from the irrigations; occasionally some dizziness followed the stimulation of the ear contralateral to the lesion. Nausea and vomiting appeared in none of these cases. In 3 patients (1) (6) (12) hearing was impaired on the side of the disease. The external and middle ears in all of the cases appeared normal.

NEW GROWTHS INVOLVING NEARLY THE ENTIRE CEREBELLUM. *Pointing Reaction.* The pointing test was used with 5 patients who subsequently were shown to have had tumors occupying most of the cerebellum at the time of the investigations. All of the reactions were normal in the first of these (1). Several weeks after a suboccipital operation, however, in which the greater portion of an extensive glioma was removed (involved the vermis, all of the left and most of the right hemispheres), the left arm deviated definitely outward. (2) In the second patient (multiple tubercles of the vermis and left hemisphere) the tests were correctly performed in the limbs, head, and trunk. Two repetitions of the examination made at intervals of five to six weeks gave the same results. (3) In the third subject (bilateral gliomatous cysts) the first investigation elicited no abnormal reactions, but a month later there was an outward pointing error of the left arm and an outward and upward error of the right. A year following these studies, just previous to a second operation, all of the reactions were found to be normal during two separate examinations. The 2 remaining patients were first studied some time subsequent to suboccipital operations. (4) One of these had been treated surgically on two occasions, the first a suboccipital decompression three years previously, and the second a partial extirpation of a huge glioma involving the whole vermis, left hemisphere and part of the right one year previously. The pointing tests were all well done during several examinations. At autopsy a few weeks later the growth was found to be very extensive—merely a thin shell of cortex remained. (5) In the second of these 2 patients a large infiltrating glioma had been removed from the cerebellum four years previously. When tested the right arm was found to deviate inward. The left reacted well in spite of the fact that it was much more ataxic than the right. This same inward error of the right upper extremity was manifest during subsequent examinations.

Caloric Test. (1) The first patient showed a spontaneous nystagmus on looking to either side, coarser to the left. On irrigating the ears in turn an outspoken nystagmus appeared—more marked from the left. As was frequently the case, the spontaneous jerks were not entirely obscured when the patient looked toward the labyrinth which was being stimulated. The caloric test on the right side resulted in reactions in the right arm only. On the left it elicited no reaction movements. The same spontaneous, outward deviation of the latter, however, persisted (see (1) under pointing tests). Some weeks subsequent to a partial extirpation of the tumor, stimulation of the labyrinths provoked a nystagmus, more marked, as in the original examination, when the left side was irrigated. No reaction movements were now apparent on testing the right ear, but on irrigating the left the right arm responded. The left arm continued to show the same pointing error outward. (2) The second subject gave practically normal reactions. There were good reaction movements in all of the limbs, in the head, and in the trunk. (3) In the third patient there was a definite difference in the reactions from the two sides. Irrigation of the right ear resulted in outspoken nystagmus, considerable dizziness, and well-marked reaction movements. Irrigation of the left, on the contrary, provoked only a slight nystagmus, no dizziness and no reaction movements. Occasionally a spontaneous nystagmus appeared with its quick component directed to the right. More marked jerks were evident when the eyes were turned to either side—coarser to the right. A month later, on repeating the tests, moderate reaction movements were obtained through the left labyrinth, and the patient experienced some dizziness. Both, however, were less marked than those arising from the opposite side (right labyrinth). A third examination made in the following year, just previous to a second operation, brought out reaction movements from the right labyrinth but none from the left. (4) (5) In the remaining 2 patients of this group, both of whom had been operated upon several years previously, no response was obtained from the stimulation of either labyrinth.

CEREBELLOPONTINE NEW GROWTHS. *Pointing Reaction.* This test was used in 8 patients having cerebellopontine new growths. (1) In the first the preliminary examination elicited normal pointing reactions. On repeating the tests several days later there was an outward pointing error in the arm homolateral to the tumor. (2) The second patient was studied on four different occasions—all within four months—the first being previous to operation and the others between the first and second attempts at tumor extirpation. In all four examinations, notwithstanding a marked ataxia in the limbs homolateral to the lesion, the tests were performed correctly. The third, fourth, fifth, seventh, and eighth patients were only tested before operation. In 2 of these (3) (5) the pointing reactions were well done, though a marked unilateral ataxia existed at the time. In another (4) there was an inward and downward pointing error of the arm contralateral to the tumor. Another (7) (cerebellopontine cyst) showed a downward pointing error of the homolateral arm. The following day all of the reactions were normal. The third examination, made twenty-four hours later, revealed an inward pointing error of the homolateral arm. The last of this group (8) gave normal reactions.

(6) The sixth patient showed an outward pointing error of the arm contralateral to the growth during the preliminary tests. Two days later the pointing reactions were well done on either side. The same normal responses followed in a third examination made one month subsequent to the extirpation of the new growth. But in six additional weeks the arm homolateral to the diseased side showed an inward and upward error.

Caloric Text. Nine patients with cerebellopontine tumors were investigated with the caloric test. (1) The first showed no response of any kind when the ear homolateral to the lesion was irrigated. Irrigation of the opposite meatus, however, resulted in moderate nystagmus and fairly marked reaction movements. There was great impairment of hearing on the tumor side. (2) The second patient reacted normally when the labyrinth contralateral to the tumor was stimulated; but no reaction movements, no subjective discomfort, and only slight nystagmus resulted when the opposite side was irrigated. A spontaneous nystagmus with its quick component directed toward the ear opposite the lesion was not entirely obliterated by the artificial jerks, *i. e.*, when the patient looked toward the ear which was being irrigated. After a suboccipital decompression, reaction movements appeared in the arm homolateral to the tumor when the test was tried in the ear of the same side. A more marked nystagmus also followed this irrigation. In eight additional weeks just previous to a second exploratory operation the responses from the two labyrinths were alike. There was a rather marked nystagmus, but neither reaction movements nor subjective discomforts. Hearing in the homolateral ear was greatly impaired. The caloric tests in the third patient (3) were without visible effect. Neither nystagmus nor reaction movements resulted from the stimulation of either labyrinth. (4) The fourth subject gave no response during the irrigation of the homolateral ear, but when the opposite side was irrigated, nystagmus and definite reaction movements (in both arms) appeared. The patient listed as fifth (5) in the report of the pointing tests was not investigated with the caloric reaction. The sixth patient (6) examined just previous to the extirpation of a lateral recess endothelioma which lay deeply imbedded in the hemisphere showed no spontaneous nystagmus. From the labyrinth opposite the lesion there followed a normal response—nystagmus, general reaction movements, considerable dizziness with some slight nausea, and falling dependent upon the position of the head. From the tumor side no response whatsoever was elicited. Hearing was only slightly affected in this ear. Irrigation of the labyrinths of the seventh patient (7) resulted in nystagmus and bilateral reaction movements from both sides. The homolateral ear, however, was deaf. A second investigation made two days later afforded the same results except that the nystagmus was considerably longer in appearing when the homolateral ear was irrigated; but the reaction movements, on the contrary, resulting from this stimulation, were more marked than those which followed the stimulation of the contralateral labyrinth. A single examination of the eighth patient (8) showed good reaction movements and coarse nystagmus when the contralateral ear was irrigated, but no nystagmus and slight reaction movements when the homolateral side was irrigated. The homolateral ear was deaf (deafness appeared during this illness). Dissimilar reactions were obtained from the two labyrinths in the 2 remaining patients (9) (10). While irrigation of the contralateral ear affected the spontaneous nystagmus and caused some dizziness, irrigation of the homolateral side had no apparent effect. The reaction movements were not investigated. Hearing was seriously impaired on the tumor side in both cases.

EXTRACEREBELLAR NEW GROWTHS LYING INFERIOR TO THE VERMIS. *Pointing Reaction.* The pointing test was studied in 1 (1) of the 3 patients belonging to this group. During the first and second examinations (several days apart) normal reactions were obtained from the limbs, the head, and the trunk. During the third examination, however, both arms deviated outward. Subsequent to a combined exploratory and decompressive operation (large glioma) the tests were again performed correctly.

Caloric Test. A limited spontaneous nystagmus was noted in the patient (1) mentioned above. It was only visible when the eyes were turned toward his right. During the first examination there appeared with each irrigation slight reaction movements in the two arms, a very moderate nystagmus, and a tendency to fall in a direction dependent upon the position of the head. The patient experienced some dizziness. The second examination (two days later) yielded somewhat different results. No reaction movements in either arm were visible and there was no inclination to sway or fall. In 2 other patients (2) (3) the vestibular responses were approximately normal.

DISCUSSION. While pointing errors of the arms appear in many affections of the central nervous system,[3] Barany believes that they always arise through changes either in the cerebellar cortex or in the efferent fibers passing from it. He explains the occurrence of pointing errors in patients with lesions elsewhere in the brain by assuming that such errors result from the cerebellum indirectly through pressure (Fernwirkung).[4] If a pointing error is present but the normal reaction movements in the affected arm are still procurable, it indicates that the error is due to pressure exerted upon the cerebellum from a distance. When the reaction movements are all elicited except the one opposite to the pointing error it indicates, on the other hand, that the deviation is the result of a cortical lesion in the cerebellum.

It has been shown that after a time the spontaneous errors disappear. To demonstrate the defect in such a case it is necessary to make use of the caloric tests. In cerebellar disease Ruttin, Neumann, Oppenheim,[5] and others describe an excessive excitability of the vestibular apparatus on the affected side (nystagmus and reaction movements).

In most of the patients reported here with cerebellopontine tumors the responses from the two labyrinths were sufficiently different to be of supplementary use in localizing the disease. In a few patients with new growths in one or the other hemisphere the reactions were likewise helpful. Pointing errors elicited in the arm homolateral to the lesion were shown to have a localizing significance by the absence of local reaction movements in a direction opposite to the spontaneous deviation. The decreased response from the labyrinth on the diseased side was also helpful in a few instances in suggesting the side of the new growth. In the majority of the cases, however, the results were ambiguous and afforded no assistance in establishing a diagnosis. In fact, in numerous instances the conclusions drawn from these results were at variance with the other physical findings, and had any great reliance been placed in them, would have led to erroneous results.

From such experiences it is evident that these tests are likely to give less consistent results in patients with tumor than in patients with other types of lesion. Barany[6] regards fluctuations in pointing errors and in reaction movements as a sign that such deviations from the normal are due to the cerebellum only indirectly —through pressure exerted upon it from a distance. In the patients with verified cerebellar new growths reported here there were numerous instances in which the reactions varied from one examination to another.

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[3] Rothmann, The Differential Diagnostic Significance of the Barany Pointing Reaction, Neurol. Centralbl., 1914, xxxiii, 3.

[4] Barany, Additional Researches on the Relations between the Vestibular Apparatus and the Central Nervous System, Wien. med. Wchnschr., 1912, lxii, 3210.

[5] Lehrbuch der Nervenkrankheiten, 1913, p. 920.

The explanation of these variations probably chiefly concerns two factors. Tumors in the posterior fossa rapidly lead to a condition of secondary internal hydrocephalus. This means a general increased intracranial tension. Symptoms and signs which might arise from circumscribed cerebellar lesions, in the presence of such an increased pressure, probably undergo considerable alteration and become untrustworthy for diagnostic purposes. In the second place most of the tumors which directly affect the cerebellum are grossly mutilating in their growth. Great areas are often involved and anatomical landmarks are effaced. From such an involvement of centres—often rapidly increasing as the tumors spread—we might expect confusing results when functional tests are tried.

The degree of intracranial tension was estimated in each case. For this purpose both the pressure at operation and the swelling of the optic nerve heads were used. It seemed possible that some relationship might exist between the degree of intracranial tension and the nature of the responses. No satisfactory evidence of such a relationship, however, was found.

As Barany,[7] Friesner and Braun,[8] and others have pointed out, in the reaction movements we have a means of differentiating between the balance disturbances due to labyrinthine disease and those of another origin. When the labyrinth is injured, Wilson and Pike[9] and others have shown that the tendency to fall is always in the direction of the slow component of the nystagmus. When the cerebellum is involved, on the other hand, the falling is independent of the direction of the spontaneous nystagmus. The direction of the falling, furthermore, does not change with changes in the position of the head. Barany found that patients with cerebellar disease fell mostly toward the involved side.

In the cases reported above, the direction of falling was almost invariably independent of the direction of the nystagmus and the position of the head. It likewise appeared to bear no relation to the side of the lesion. The latter feature has been discussed more fully in another place.[10] Frequently irrigation of the homolateral ear had no effect on the spontaneous falling, whereas stimulation of the opposite labyrinth resulted in a labyrinthine type of falling.

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[6] Demonstration of Patients, with Comments, Wien. klin. Wchnschr., 1911, xxiv, 1173.

[7] The Vestibular Apparatus and the Cerebellum, Brit. Med. Jour., 1910, ii, 1245.

[8] Loc. cit.

[9] Vertigo, Jour. Am. Med. Assn., 1915, lxiv, 561.

[10] Grey, loc. cit.

Neumann,[11] among others, believes that each cerebellar hemisphere exercises control of an inhibitory nature over the nystagmus directed toward its own side. Tumors and other lesions which destroy a hemisphere abolish this inhibitory influence. Accordingly, in such cases, when the labyrinth contralateral to the disease is stimulated with cold water a nystagmus toward the affected side follows which outlasts a normal reaction by several minutes. This so-called enduring nystagmus may last from five to fifteen minutes or more. In the cases with hemisphere tumors encountered here no considerable endurance of the nystagmus was noted. Frequently differences were observed in the responses from the two ears, but usually these were due to a diminished reaction on the diseased side. These findings seem to be in accord with the results obtained by Bauer and Leidler[12] from extirpating different parts of the cerebellum in animals. They found that so far as the cerebellum itself is concerned an increased excitability of the vestibular apparatus only appeared from lesions of the vermis.

Barany[13] and others have found that most of the cases with brain tumor in which there was a considerably increased pressure in the posterior fossa experienced very little subjective discomfort from the caloric tests. The appearance of much dizziness and nausea and of vomiting speaks against a process in the posterior fossa. The results from the irrigations reported here entirely agree with these experiences.

CONCLUSIONS. The caloric test has proved to be an important means of differentiating labyrinthine from intracranial disease. Together with the pointing reaction, this test has been found of value, furthermore, in localizing circumscribed lesions in the cerebellum. The present report has to do with the results obtained from using these tests in 31 patients with cerebellar or extracerebellar tumor.

In most of the patients having cerebellopontine new growths and in certain of those with tumors of one or the other hemisphere, the reactions were sufficiently characteristic to be of supplementary value in localizing the disease. This suggests the desirability of a further study of these tests in neurological diagnosis. In other patients with intra- or extracerebellar tumor, on the contrary, the results were often ambiguous and afforded no assistance in establishing a diagnosis.[14] In fact, in numerous instances the conclusions drawn from these results were at variance with the other physical findings, and, had any great reliance been placed in them, would have led to erroneous results.

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[11] Quoted by Friesner and Braun, loc. cit.

[12] Concerning the Effect of Excision of Different Portions of the Brain on the Vestibular Eye Reflex, Arb. a. d. Neurol. Instit. a. d. Wiener Univ., 1912, xix, 155.

[13] Loc. cit.

[14] Since this paper was prepared for publication the pointing reaction and the caloric test have been studied in about a dozen and a half additional certified cases of cerebellar tumor. The conclusions drawn from these examinations differ in no essentials from those outlined above.

There are probably a number of factors responsible for the occurrence of atypical reactions in patients with certified cerebellar tumors. As the more important we may mention first, the great increase in intracranial pressure due to an internal hydrocephalis which ultimately accompanies new growths in the posterior fossa, and second, the diffuse nature of many of the tumors common to the cerebellum.

A CASE OF PRIMARY SPLENIC HODGKIN'S DISEASE.

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Since 1832, when Hodgkin reported 7 cases of the condition which now bears his name, the etiology has been unknown, and until recently its pathology was ambiguous. But through the efforts of Reed, Longcope, Andrews and others an histological picture has been established which undoubtedly places it among the disease entities and separates it from several conditions with which it has been confused. Most prominent among these are tuberculosis, lymphosarcoma, and pseudoleukemia.

Sternburg,[1] in 1899, held that it was a special glandular form of tuberculosis, just as lupus was a special cutaneous manifestation. This view is no longer tenable in light of the proof that lymphatic tuberculosis and Hodgkin's disease may coexist. At the time this case was autopsied the diphtheroid organism had not been promulgated as the probable cause of the condition. The etiology is far from settled yet. The later results of the vaccine treatment have not given the ground for hope that some of the earlier over-enthusiastic reports afforded.

Characteristically, the disease has its origin in the cervical lymph glands, but cases of anomalous origin have been reported from time to time. Parkes Weber[2] reports a case primary in the bronchial glands. The first signs in this case were cyanosis and edema of the extremities, with osteo-arthropathy as a prominent terminal feature. Symmers[3] reports 2 cases primary in the retroperitoneal lymph nodes, and others having this origin have been reported previously.

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[1] Ztschr. f. Heilk., 1898, xix, 21.

[2] Proc. Royal Soc. Med., 1909, ii, Clin. Sec., 66.

[3] Arch. Int. Med., 1909, iv, 218.